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INTERVIEW WITH DR. THOMAS PARNELL
INTERVIEWED BY STEPHEN P. WARING
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1. WARING: First of all, can we start out by having you describe to me how you came to Marshall?

2. PARNELL: Yes, I was recruited to work in the an office called the Experiments Office which was located in 4200. It was an office in Science and Engineering under William G. Johnson who was the head of that office. He in turn worked for Herman Wiedner who was the Director of Science and Engineering or its predecessor organization.

3. WARING: What year was this?

4. PARNELL: '67, August of '67. The office was to handle all of the Center's research and technology operating plans, RTOPs, the SRT funding it was long-range research. It was administrating it. My assignment was to look into several areas from a technical standpoint since I had a Ph. D. in physics and a little bit of laminal research experience. In particular I was to look at the areas that had to do with the particle research, the radiation environment of the earth and as an offshoot, to look at costal manufacturing in space at that time. It's now called micro-gravity. It used to be called manufacturing in space and it's space processing and then microgravity is the way its termed. So, I did that for approximately a year and a half for Bill Johnson. The agreement was that at the end of that time, if I wanted to move to a research organization that was fine. He would recruit somebody else for that spot. Had his philosophy being that he wanted someone fresh research experience rather than turning them into a sort of an administrator. After a year and a half I moved to space science lab and got involved with the small amount of cosmic ray and other kinds of particle research that were going on here at the time.

5. WARING: Now, at the time you were hired was Marshall trying to hire more scientists, more people with doctoral backgrounds in astrophysics?

6. PARNELL: Not too actively. The more recent buildup that we've seen in science came on later after Marshall got it more in assigning the programs . . .

7. WARING: More in the mid-70s?

8. PARNELL: Yes. Marshall, about the time it was formed in 1960, had a few associated science programs that came from the Explorer-1 era when they launched [?38] instrument. [?39-40] They were flying an instrument of two, instrument unit, on the Saturn. Instrument unit was the ring at the top that carried the controls for the Saturn and I had some instruments that would flap up, actually astronomy instruments. Then they were actively planning about 70 or so a few years after I came, Skylab. Skylab had a compliment of scientific instruments, the chief compliment being the Apollo telescope mount which was the solar point in a cluster of instruments on Skylab. During those days there was a more active interest in science, for science safe at Marshall and in space science lab. Later on Marshall took on the HEAO program, the High Energy Astronomy Observatory program. That's when there was an interest in broadening scientific staff at Marshall to act as project scientists, to act as project advisors, but with the recognition that, if a person were going to do that and be effective he would have to be an active scientist doing his own research. Otherwise he wouldn't have the credentials to talk to the principal investigators from outside. I was initially, when the HEAO program got started in the 1969-70 time frame one of the project scientists, the alternate project scientists for the HEAO program at that time in high energy astrophysics headquarters deemed that Goddard had the expertise, serious expertise, in that area and they appointed Frank McDonald from Goddard who was one of

the fathers of the HEAO program in terms of getting it started, as the project scientist and I was his alternate at Marshall, understudy you might say.

9. WARING: Okay.

10. PARNELL: Then later I became the project scientist for HEAO-3, the third mission.

11. WARING: How was it that Marshall got the HEAO satellite?

12. PARNELL: Well, through a series of considerations, I'm not privy to all of them. A group was formed, sort of appointed by headquarters to look into this. Frank McDonald of Goddard was the, I guess he was the, sort of the principle field center scientist. Al Shart and [?78] at headquarters who were running the astrophysics program at the time. There were people from most of the NASA centers involved. I got appointed to that group. There were some university scientists, some of them rather prestigious. Two Nobel Prize winners, Hofsteader from Stanford and Al Resh from Berkeley. People interested in cosmic rays, [?83] astronomy and gamma ray astronomy were involved. This group met off and on trying to define what the space craft would look like, what the compliment of the experiments would be on each space craft what the general scientific objectives were. When that was settled all in this group my impression was that headquarters and Frank McDonald had a tough time selling this to Goddard as a new program 'cause Goddard was quite busy at that time on a lot of other things. I'm not sure what their work load was but they had things like [?92] coming along and a series of previous missions like OAO and the orbiting solar observatory. So, this committee asked is there another center that's willing to take it and I pointed out the Marshall's work load was going down the hill as far as the Apollo program was concerned and it might be advantageous to bring [?99] up here at Marshall. At that time an approving development organization had been just formed with

Bill Lucas as the head of that and Jim Downey who moved over from this lab. Jim was in this lab for a while. He was a nuclear engineer that had been working on nuclear propulsion. He moved to PD to I set up a meeting between the headquarters contingent, Frank McDonald and the PD management, and they struck it off and decided that this would be maybe one of the first major [?8] development phase-A in-house studies. That's the way it turned out and it kind of went from there.

13. WARING: Was there a feeling that Marshall had greater managerial expertise for larger projects, something that Goddard did not have? Was there a discussion along those lines?

14. PARNELL: I suppose, there were discussions of that kind although it was also felt that Marshall didn't have much experience in scientific programs. I think the principle reason for Marshall accepting it and Goddard not and headquarters endorsing that was just the distribution of work load at that time.

15. WARING: That makes sense. Was there, even though Goddard had a full plate, was there jealously from Goddard that this series of satellites was assigned to Marshall?

16. PARNELL: I think there was considerable evidence later that that's true. John Clark, the director of Goddard at a meeting here, berated people for not having a way to balance science on board like in optical astronomy for example and later when the HEAO program came to an end and they talked about HEAO Phase Two which was to be another HEAO but larger, Goddard made an active bid to take over HEAO Phase Two and in deed the gamma-ray observatory is one of the vestiges of HEAO Phase Two. Of course AXAF is also some of the remaining of HEAO phase two.

17. WARING: AXAF is going to be done at Marshall?

18. PARNELL: Right. And the Gamma Ray Observatory was a Goddard project. However we had one of the four instruments on board in our group. Jerry ~~Fisherman~~ Fishman is principle investigator, four investigators here and one at UAH so that Goddard when it is to California at San Diego. GRO wise, it is a Goddard project hopefully to be launched next March.

19. WARING: At the time NASA was moving into the HEAO series, there were terrible problems with the budget. In what ways did the budgetary problems affect design and development of HEAO?

20. PARNELL: Well, HEAO was originally envisioned to be about a 25,000 pound space craft Titan launched with very large instruments. I made a proposal, as well as several other people including Goddard LSU and [?148]. We got accepted on the old HEAO program in 1972 or 3. That was a huge budget crunch and HEAO was cut out, but thanks to Fred Speer and the PD people here and the people at headquarters they were able to reconstitute HEAO into a much smaller program. See there was a 5,000 pound space craft with a smaller estimate to fly on the Atlas; a much less costly program, less ambitious. I think between Fred Spear and the people at headquarters, they convinced headquarters and Congress they could execute this program [?160]. One of the most beautifully managed programs that the [?161] had. I think we can thank Fred Speer for that.

21. WARING: During the time the HEAO was cut out, were there efforts to build a coalition of scientists to put pressure on the agency?

22. PARNELL: Well Yes, but there was a whole lot [165]. My experiment fell out, never

flew, the one I was involved in. Several others including Hofsteader's [167]. Hofsteader's is now flying as part of the GRO mission, but that whole controversy and the attitude of the time and the efforts to rebuild the program in a very short time, all of this would be done in a month or six weeks. We just sized everything down, decided what were going to fly. It's really described graphically in a book called The Star Splitters about why it's tougher and they surely have it over in the [175]. I believe it was a NASA SP although it was published in a hardback and it's a well written [178] is a good science writer also an x-ray astronomer.

23. WARING: Well very good. I had not heard of that book.

24. PARNELL: It's a good book. I find a little faulty with it in the sense that some of the early history that I told you about is not covered exactly, but I have some files that I could show you on that stuff [182]. That's a good book and it details the history of the HEAO program very well.

25. WARING: Okay. Thank you very much for that information. How was, how were the HEAOs designed? Is it essentially team work by government personnel and by academic scientists? Can you give a sort of general description of that process?

26. PARNELL: Well, it's a somewhat complicated process. The science experiments are generally solicited by headquarters and there's an announcement of opportunity in their proposals. The announcement of opportunity outlines some general constraints that the space craft will have so that the people proposing have to confine themselves to this to a flying space craft or a spinning space craft general weight ranges, power, and that sort of thing. Then a certain complement is selected. Quite often it's oversubscribed so there's a down selection later, but after a couple years study and the final experiments are selected, then there is a science team for each mission. That science team usually operates from the

chairmanship of project scientists who at Marshall has a somewhat nebulous role on paper. He doesn't have any direct line of authority on the project, but . . .

27. WARING: The project engineer is, chief engineer is in charge?

28. PARNELL: Yes, the chief engineer, the project manager then the chief engineer below him. The project scientist usually is sort of an intermediate link, I mean he's not into communication link because the, you know he doesn't pass paper but I can form the plan with him. Experimenters and the scientists in the project, but he acts as sort of a science alter ego for the project. If he is effective and the project manager listens to him, then he may have some influence over decisions that are made. For example, altitudes or orbital inclinations that may be influenced by the [221] or the viewing program of the instruments or things like that. The project manager's chief responsibilities are to complete the program as set down in that program document. Complete these observations and a number of things within costs and within schedule as much as possible. The chief engineer is supposed to take care of the more nitty gritty day to day things. Of course typically the space craft is contracted out so you have a lot of players, you have the space craft contractors, you have the experimenters possibly within an independent instrument contractor to build the instrument and sometimes they do it at their own institution like a university. Then you have the project management, and the project engineer, and the project scientist and how they play together influences a good bit of the success of the program and how it's viewed by the scientific community headquarters. If it creates great science and it comes in on cost and on schedule, that's wonderful.

29. WARING: But if it doesn't . . .

M: But if it doesn't, it's after the fact. They're all right though. HEAO had a few but they

weren't disasters, all experiments have a few but others having more than most. I think how that team plays together makes a lot of difference about how it comes out. Of course there are other things like funding constraints. Whether the scientists are really talking to the engineers early enough to get full definition or whether the project manager, the project engineer [251] through paperwork artists and don't really think about the engineering and science and [252]systems engineering.

30. WARING: But this, in your opinion during, the HEAO things worked well?

31. PARNELL: They were tense at times, very tense because money was tight, schedule was tight, a lot of strong personalities involved but they worked. In my opinion they worked very well. If they hadn't, we wouldn't of have the three HEAO missions. They would have been cut off because the money's gone.

32. WARING: Why was it when Marshall was moving into these big science projects that they did not give a, make a stronger position for a project scientist?

33. PARNELL: Well, there was an understanding among the engineering community at Marshall and still to some extent there is not what a scientist does. They're still [268]. If you talk to some of the old timers here who are good engineers but haven't worked a project this size from beginning to end, the feeling that scientists do things every bit esoteric and not very practical. That is true at times. You wouldn't chose a theoretician to do a [274] project and headquarters normally didn't select them that way. There are scientists that are not too practical, but are very feisty. I think John is speaking initially there was a thought that slightest input wasn't too important. He should write his requirements out on paper initially and then get out of the way. Anybody that develops an instrument or a space craft or anything else from beginning to end knows that this is not the

way it happens. You might write down requirements, but if you write them down and freeze them to early in the game, you're asking for a hell of a lot of trouble.

34. WARING: Because you can encounter unforeseen problems and technology changes?

35. PARNELL: Yes, so the scientists and engineers and managers have to have good communication with the early part of the program before all the lines are drawn in the sand [289] like Saudi Arabia you can't change anything.

36. WARING: Were there ways that were developed in this project for making sure that the scientists and engineers communicated with one another? Were there management procedures? Regular meetings? How was the communication worked out?

37. PARNELL: I think there was some fortunate things that happened there. I think the initial response, and I even remember a meeting in which, it's described in this book Star Splitters, in which Fred Speer, who hadn't had much, any experiences was assigned to be the space craft project manager came in an said 'this is what you're going to do. You're going to [300] this document , deliver that document and this document. Damn it you're going to do it and then we're going to build everything from this document. That's all there is to it.' He had such a strong personality was dead quiet and everybody looked at each other. You knew what they were thinking: Oh shit! When there was some behind the scenes explaining what was going on that there had to be some better communication than that, than just words on paper. The second thing was that at that time, Marshall had a , quite a large cadre of design engineers who were extremely good. They'd worked on Apollo, on Saturn, on Skylab, and they had a lot of hands on experience. The programs were winding down and they were looking for a promotion or to move up to project manager. So each one of those experiments had a good experienced Marshall engineer

that was assigned to it. Eventually that was under the S&E organization with Fred O'Tally in charge. Hanz Spickner I guess was the original director of that group. Hanz was one of the old [326] group, a very practical fellow. A little authoritarian, but easy to talk to. Between those experiment engineers and Hanz Spickner they mediated with the project and with the rest of Marshall and they acted as the local resident representing that experiment. In most cases there was a good repartee between them when Marshall assigned budget, engineering, and experimental representative assigned us. So, they got a lot done. Really, a huge number of little nitty gritty things that happened to the experiments. Things didn't work out right, problems at the last minute with the instrument and that kind of thing whereas today it would cause forty of fifty people to sit down for days on end let alone 4200, 4201. But in those days, were worked out with a very few people.

38. WARING: At a lower level?

39. PARNELL: Yes, at lower level. Then you'd come in and sit down with Fred Speer or Carol Daly and tell them what it was. Very seldom did they try to work these things in real time in a large contract because the Grumman engineer had done his job made his recommendation. It worked out well. Now, I think these experiments engineers, they're not as many of them and that case they're not as experienced and we have a lot of more scientific projects so one guy may share five or six projects and if he can't learn enough about it and get to know its problems and people to the interface.

40. WARING: Do you think this younger generation of engineers has the same sort of hands on experience that the older generation did because their knowledge is really theoretical and mathematical and that sort of thing?

41. PARNELL: There are still some of the handson types around, but I would say by and large the numbers are fewer and the experience level is less. Not in every case, but in many cases there were the fast number years and that's turning around now. There was a tendency to take young ones out of school and quite frankly the engineering schools don't give much hands on experience anymore except with the computer terminal. The guy thinks that everything that exists is behind that screen which is not true. For a while here at Marshall, if a guy was glib and looked good in a suit, he quite rapidly graduated to the conference room. That's the worst thing you can do to an engineering organization is put a guy in technical management when he hasn't built something himself a few times through the school of hard knocks to see whether he can make something work or not before he starts telling other people how.

42. WARING: A lot of people have said something similar I think.

43. PARNELL: I'm not saying the management now at the S&E level and higher are giving good-look service to turning that around. I think I see some evidence of it, trying to run people through a project in which they have to design and build something before graduating to the conference room. I still see a lot of people less than two years out of school with a B. S. [?388]

44. WARING: Do you think that's . . .

45. PARNELL: It's bad for them and I don't think it's good for their organization.

46. WARING: Do you think the reward system changed to reward people who were, who had accounting skills, and . . .

47. PARNELL: You know it's always common knowledge in organizations like Marshall and even in the industry - pay level to get into management, but the other thing that's happened is that there was a large dismantling of in-house projects at Marshall. The machine shop almost shut down - and all that kind of thing and that's been turned around to some extent. But I still think it should be an iron clad rule that the guy doesn't get in the conference room until he's shown what he can do or can't do of it out in the labs in terms of producing an engineering project.

48. WARING: During the time of HEAO, how much , how much work was done in-house? How much work on the hardware was done in-house?

49. PARNELL: Hardly any on the HEAO project. In fact none. The experiment I was working on we were going to build part of it here at Marshall, but there was a lot of in-house work going on at Marshall on various programs. You know the Apollo Telescope Mount was built in-house. There was a fairly large infrastructure of doing things like that.

50. PARNELL: Why wasn't anything done on HEAO in-house?

51. PARNELL: Well . . .

52. WARING: They lacked the skills necessary to complete the sort of instruments that were being on board?

53. PARNELL: There was some discussion about it. This was during an era in which the thought pattern, and this of course was encouraged by industry, the government shouldn't do anything in-house. That was a waste of government money and particularly money that could be channeled into industry. I think in that. I think that you should not build

everything in a government organization, but if you don't leave part of it to be done in-house, then we quickly loose the field for managing projects out of house. That's my opinion. Incidentally, if you, I don't know whether you read Neville Shute, but it's not popular anymore produced by an Australian author, but at one time was largest selling author writing in English On the Beach.

54. WARING: . . . On the Beach?

55. PARNELL: He wrote a little biographical thing called Slide Rule. You might like to read that sometime, but it's in there as a controversy about whether government organizations should be allowed to do anything. He was strongly opposed to it. He had worked in the British aircraft industry for a long time. You know that's an interesting saddle.

56. WARING: Could you discuss what were some of the, what do you think were some of the most important achievements for the HEAO series?

56. PARNELL: You mean the scientific achievements?

57. WARING: The scientific achievements.

58. PARNELL: Well, they're covered in Star Splitter fairly confidentially, but there were several thing. There were three sort of subdisciplines in high energy astrophysics. One is cosmic ray research which is my principle area, actually astronomy and gamma ray astronomy. HEAO continued to work that had been done on earlier missions like the small astronomical satellites one, two, and three with the Goddard project in surveying the sky in x-ray astronomy and gamma astronomy and really brought those to a level that was

no longer, the surveys were so complete that those disciplines were no longer in what I'd call the surveying and the taxonomical phase that they were studying, instead of x-ray astronomy and gamma astronomy, they began to studying specific objects in much detail, so they elevated those disciplines from the survey mode to the astrophysical examination mode of unusual objects, particularly HEO-2 which was at the Einstein Observatory, which is the precursor of the AXAF. That is one thing.

The second thing is that the phalowsync [?] rays, the full cosmic rays abundance spectrum from hydrogen 3 uranium was measured in a lot of detail and settled a lot of questions about the origins of the cosmic rays and the giant solaration mechanism and that sort of thing. So there were numerous scientific questions settled. Of course, there were a few new ones raised as far as new future programs.

I would say that we had a complete survey of the x-ray sky at a high sensitivity and studying the individual object at Einstein determining a great many things about quasars, about inactive stars, black-hole candidates. We discovered that at a distance we are making up a lot of the general x-ray diagrams from more than just a cosmological glow. WE discovered that all kinds of normal classes of stars emit x-rays from a certain conditions or during certain phases of their evolution. A huge number of scientific discoveries.

In addition, from a management standpoint, it was pretty much on schedule and pretty much within cost.

59. WARING: What consequences did the HEAO Project have for Marshall, do you think? What difference did it make in Marshall's history after the project? Did the Center gain in prestige in the science community?

60. PARNELL: Yes, very much so. It also changed the attitude of the Center about being a multi-program center. ...a lot of fun in Space Lab. A lot of scientific programs. Of

course, during the course of the HEAO development, while HEAO was being developed, Skylab happened to. Skylab was a little bit bigger than that, but HEAO was a broad scientific program of the atmosphere and just learning how to cope with it. I think that it took on a lot of future Space Lab missions because of it. Of course, Jim Downey who was the on the program development from the beginning and then the first meeting at Marshall about HEAO, eventually became the Space Lab, payload projects, not just Space Lab, all of Marshall's payloads that are in propulsion. So you can see the training that program gave the people at the Center to do multiple scientific missions for the future.

61. WARING: So it would be more elevating the prestige of science inside the Center, elevating the prestige in the outside community.

62. PARNELL: Proving the headquarters at Marshall could be flexible to do that. This is my point of view, of course.

63. WARING: Yes, well it is a reasonable point of view. Do you think that there were lessons that were done doing HEAO that were applied to other projects?

64. PARNELL: Yes, I think so. Well, universally applied are well applied in every case, but I think the main thing that become apparent was that we had to be a little bit more flexible in your measurements, style, paperwork, legitimacy, with science programs. You were dealing with an animal that defied putting requirements on papers ten years before you fly it and nothing change it. Of course, the Apollo Program was that too, except that then they had enough money to solve multiple problems, so you sat on several different approaches, something that you can't do with scientific programs. We are always in a money constraint at NASA. Right now if I were to hire watermark as far as money being spent on scientific programs which is about 20 to 25 percent of the budget, that is including

the observatory of course, which is not all pure science. When you get down to how we much we spent on the experiments, and on (?) analysis it is probably ten percent of the budget or something like that. But, management at Marshall had a lot of experience and you could see some of the same people in the Spacelab and in other programs.

65. WARING: Is there connections between HEAO and the Space Telescope?

66. PARNELL: No.

67. WARING: They were separate projects?

68. PARNELL: They were entirely separate projects for two reasons. One, the security aspects or whatever reason it was that kept the space telescope isolated. There was something that kept it isolated. Of course, when HEAO ended, when HEAO flew, Fred Speerman who was with the space telescope, and then later on when HEAO's main screen was removed from that job because of cost overruns and that kind of thing. The space telescope was in terrible shape when we got it. That's my opinion of what I have heard. Some of it is not all rumor. It is well-known now. That is also the Marshall style. Somewhat ramrodded by Bill Lucas, you don't tell headquarters your problems, until you absolutely have to. There was a little bit of information flow that I knew that Fred was restricted in that area on HEAO, because I was on some meetings that I heard that things.

I think that it was difficult to clean up the problems that the space telescope had in a short length of time to make it fly. They were too structured in the people that were working there and the way that the project was divided among contractors.

69. WARING: Plus the terrible funding.

70. PARNELL: Plus the terrible funding problems.

71. WARING: Robert Smith's book on the telescope is very good, I don't know if you have read it.

72. PARNELL: No, but I have heard about it and I would like to meet the guy.

73. WARING: He has a scientific background. But from my perspective as a historian, there is a lot to be admired on his approach to studying the evolution of the telescope project.

74. PARNELL: I have heard a lot about it because Bob O'Dell, the project scientist had two people working here in this lab and they were assigned to me to administer at that time. I didn't work with them in the science, I was working with O'Dell. I got to hear a little bit about it, and indeed we didn't go through a (?), we were asked to do a few analysis for Space Telescope on the fine guidance sensor. We estimated somewhat of an upset rate. The guys that work down here with us, exacting what they are observing now. We learned a little bit about it. I think that we were really in bad shape in 1970, I am glad we got it. Then when things really got out of hand a few years later it was making a sacrifice, that's my opinion. I don't think that he wanted the project to begin with. I think he wanted all management positions. When they told him that this was the only thing that we would get. That's the rumor.

75. WARING: What project did you move on to after HEAO?

76. PARNELL: Well we went back to our balloon-flight projects. We had been flying instruments on board, cosmic rays, gamma-rays, astronomy.

77. WARING: How long has Marshall been doing that?

78. PARNELL: Well, they were doing it to some extent, somewhat slightly, before I came. There were two projects that were in-flight projects. One was in gamma-ray astronomy. That was a joint project with Oakridge Laboratory. Wallex Parker in his lab was assisting the Oakridge people.

The other was a telescope project. I think Lyman Spitzer was ...anyway an optical telescope. The project in Princeton that originally had been contracted out of (?), couple of contractors and Marshall took it on for the last flight or so, which was after I got here. I think that we flew our first balloon flight here out of this group in 1970, 1969. That was an instrument home-grown here at the lab. Since then we have flown at least one balloon flight a year on the average.

79. WARING: Is there any single or series of written sources that could document the history of that? Are there project reports or summaries, series of project reports?

80. PARNELL: I almost started a list from the beginning, I think that I still have it in the laboratory there. We stopped counting here a few years ago, but we could bring it up to date. Time, launch, location, recovery location, general objectives in flight.

81. WARING: We would be interested in reading those, otherwise the balloon flights could fall through the cracks of history!

82. PARNELL: I think that is an important area.

83. WARING: Obviously the big projects, like the shuttle or Saturn get heavy exposure.

Marshall has a strong Space Science component too.

84. PARNELL: In the last couple years Marshall has flown some balloons for atmosphere....

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85. WARING: ...that would be very useful. Would the reports be in the documentation repository?

86. PARNELL: No, the Balloon-flight program is handled under the SRT, HARTOG system. We don't have to deal with the rest of the Center unless we need help. We document it, but the documentation is sufficient for the small team that does the balloon flights to know whats (?) and how to fix things in a hurry and that sort of thing.

They usually result in a scientific publication or something like that. Occasionally a description that makes up a literature list.

87. WARING: Yes, that would be helpful, or even a brief one page memo of some of the achievements. Is that sort of independent process for you folks in Space Science a way giving you the autonomy as if you were in a university setting?

88. PARNELL: Well, it really serves a couple of purposes. One is, most people are lucky if they get a major experiment per career on the spacecraft, because of the infrequency of the opportunity and the cost of the experiment, and a number of people are required to make it work. Whereas you can typically conceive of an instrument of an observation that you want to make, and build it and fly it on a balloon in a couple of years. For a cost that is sometimes thousands of dollars, some are more expensive, but our most expensive

equipment in this range about 45 thousand dollars, that was a precursor to our gamma-ray observatory instrument, which was costing 12 million. So if you can do it more frequently you can get observations, you can publish results, you can stay active as a scientist. Whereas if you only did it on spacecraft, you would forget what it was all about while you were doing the instrument.

89. WARING: You would become a manager probably!

90. PARNELL: Yes, well, a lot of us have done that anyway!

The second purpose is at least in certain fields like cosmic rays and gamma-rays astronomy it is almost a pre-requisite to demonstrate that you have a good concept with an observational balloon before you can get accepted for a spacecraft.

91. WARING: It is sort of testing the instrument.

92. PARNELL: Yes, you can make observations from balloon altitudes which are 125,000 feet. Cosmic rays, gamma-ray astronomy, hard x-rays, ultra-violet, infra-red, so there are fields that you can get high enough to do all the scientific observation, prove you instrument concept, prove you know what your instrument background is, know what you are doing. Then publish a paper to, it's a lot easier to get them accepted on the space probe. The reasons I am giving here are NASA's reasons for coming into the programs. So it is an important component of NASA's Space Science Program is to keep people active in universities and the NASA Centers, while waiting on the great flight in the sky! Which, incidentally, we started GIO, we got our own proposal in 1978, here we are in 1990 still waiting around for a part. It will hopefully fly in 1991, so we are talking about 13 years from thought to flight.

93. WARING: Marshall is not primarily known as a space science center and...

94. PARNELL: That is changing.

95. WARING: That is changing, but in your time at Marshall has this caused morale problems or turnover problems, more so relative then say Goddard or ...?

96. PARNELL: Yes. If you look back at the history of the Space Science Lab, you know that, I could give you a fairly long list of people who have come and left. It is not always because of dissatisfaction with Marshall, sometimes the family is from California and doesn't like Huntsville or something like that. But, nevertheless, Marshall's handling of the Space Science Lab has been rather uneven and not consistent. We are seeing some changes going on now. So good and some bad. The good part is that the Center has recognized both the need for a corps of scientists if we are going to handle a lot of scientific programs and also the lab equipment that they do need to be able to do their science. Both of those views have continued to improve. What has been uneven is what is required to make a scientific organization possible. Even whether you want it to prosper very much or not, if you just want to keep it at the residual level, do the projects before it, things like engineering support, we have been fortunate to work with some very good engineers that work in our laboratories along side us and help us with our dullified instrument and accelerated experiments. Also upon occasion when we had a space flight instrument, they really know what is important and what isn't in their interface with the project. That is a tremendous asset. But, right now the Marshall management no longer sees a strong need for that. I am not talking about bad management, but Marshall management would like for us to get our engineering support from afar like another laboratory. That is almost akin to depending upon a contract programmer to do your program for you. So it is much less efficient way to handle it. So that is just some of the ups and downs.

I would say that overall the Center now recognizes that we have a sound scientific laboratory that is competitive in many areas with the outside scientific community and that they need us.

97. WARING: Do you think that is the biggest change in the role of Space Science at Marshall since you have been here?

98. PARNELL: Other than the growth and the soundness in individual disciplines, yes. There has been a lot more of a tendency for the certain scientific areas, the scientific teams to firm up into what you call "critical mass" and let the people get work and put them in the international prominence. We have quite a few areas in the lab that are competitive on the international scale. Gamma-ray astronomy being one of them. Cosmic rays another, x-ray astronomy in another. Solar physics down in another area. Micro-gravity. Some areas of the atmospheric science, I don't know them too well.

That wasn't true years ago, there were just a few seed groups in a couple of areas. Not so many really sound groups that were publishing on a regular basis.

99. WARING: Is there anything else that you think a historian at Marshall should know.

100. PARNELL: No, I think that I have given you enough that they can hang me!